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AK215R AK216R AK220R AK300R AK305R AK315R
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(58) Field of Search

UK CL (Edition N) H1P PHC , H1T , H2A AKD2 AKD2C
AKD2D AKF1 AKH1 AKH2 AKH2A AKN2A
INT CL⁶ H01F 5/02 5/04 5/06 41/06 41/12 , H02K 3/18
3/34 3/40 3/52 15/02 15/04 15/06 15/095 15/10 15/12

(54) Dynamoelectric machine rotor and method for preparing it

(57) A dynamoelectric machine rotor comprises a rotary shaft 1, a field core member 2a, 2b, engaged with the rotary shaft, a field coil 31 wound on a bobbin 32 on the field core member, and an outer circumferential tape 36 which is wound on the outer circumference of the field coil to prevent the field coil from unwinding. The outer circumferential tape includes a substrate sheet 361, which is provided with a recess 361a and/or a projection.

FIGURE 3

FIGURE 2

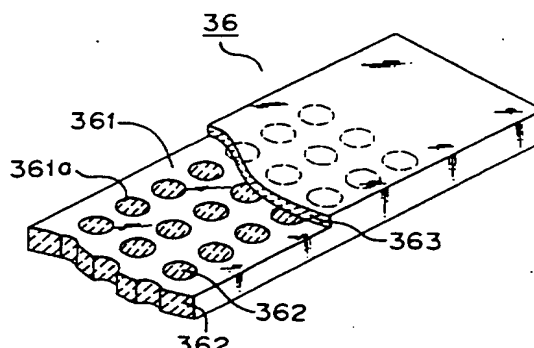
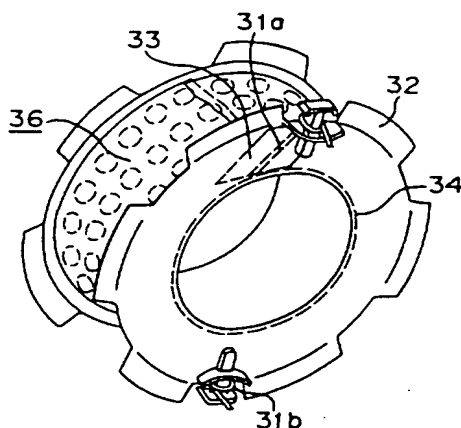


FIGURE 5

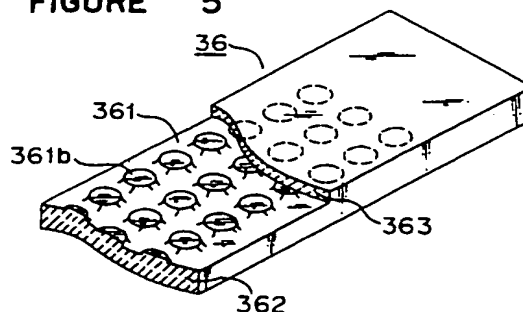


FIGURE 4 (a)

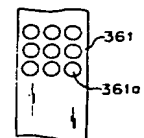


FIGURE 4 (b)

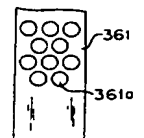
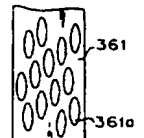


FIGURE 4 (c)

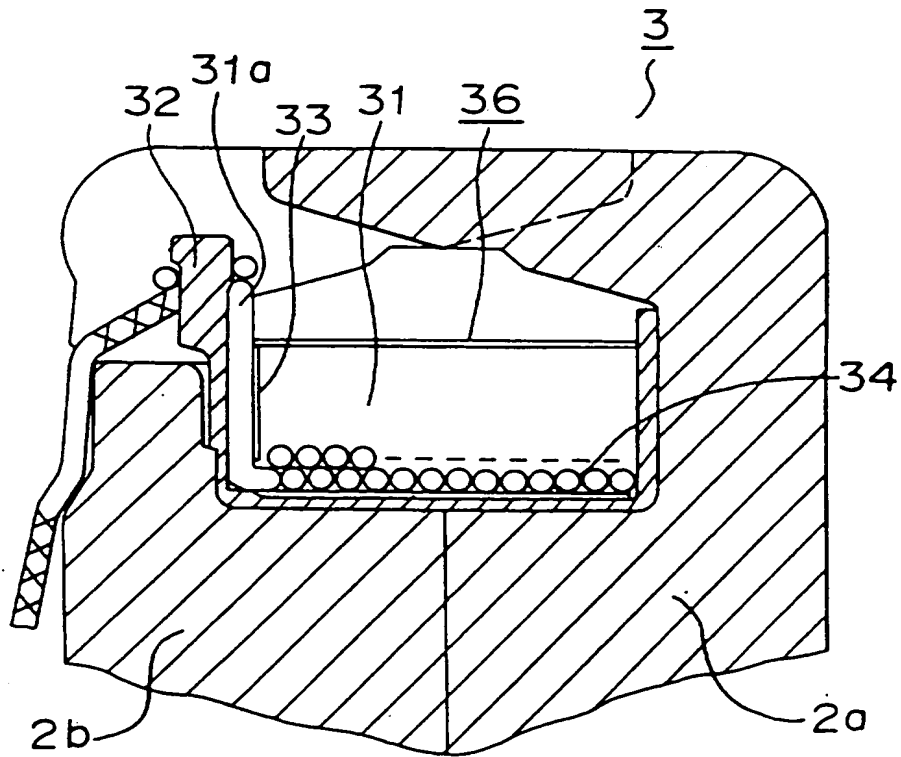


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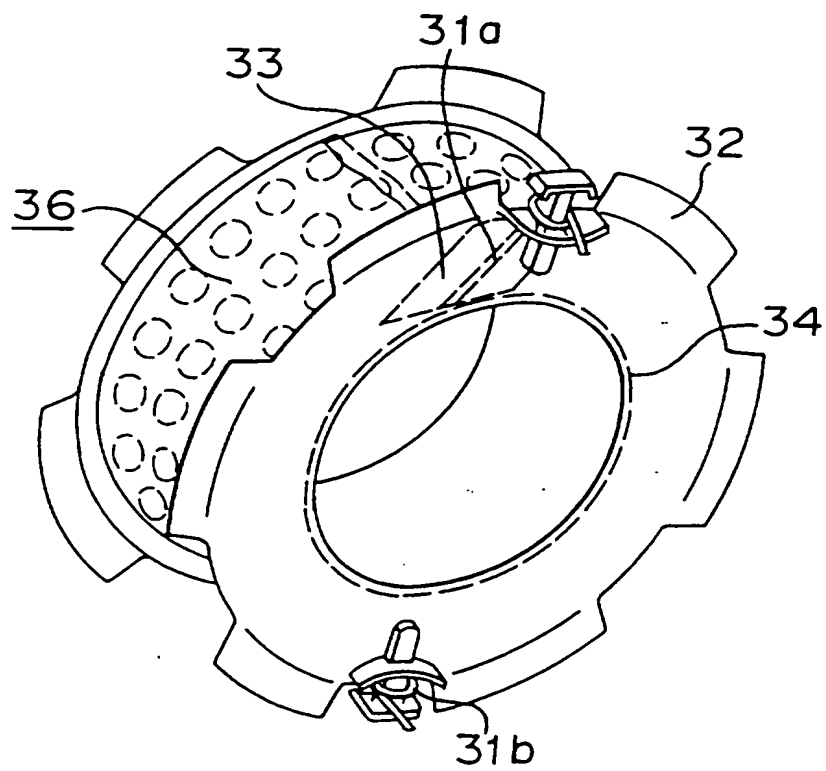
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FIGURE 1



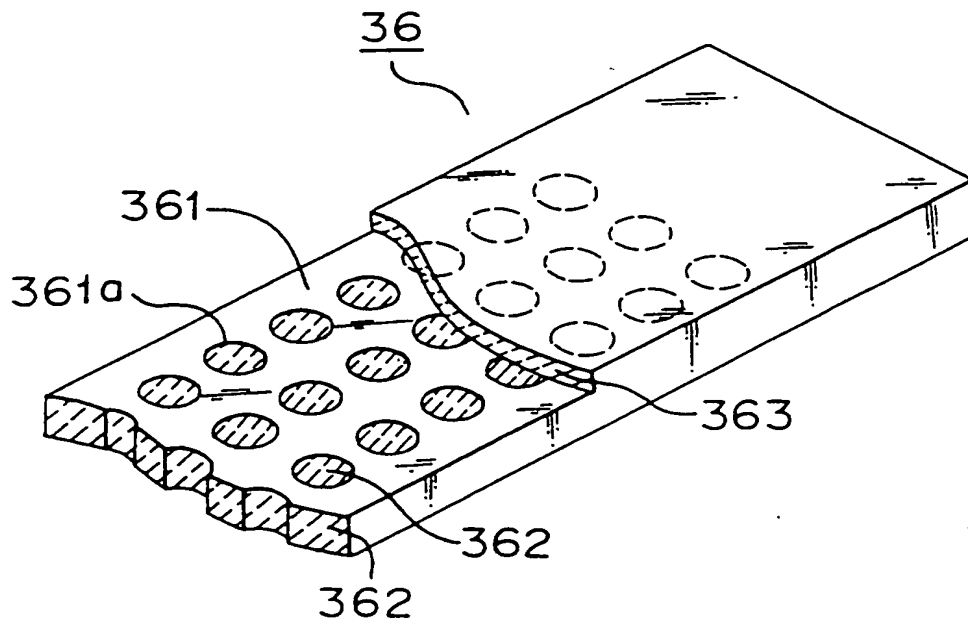
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FIGURE 2



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FIGURE 3



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FIGURE 4 (a)

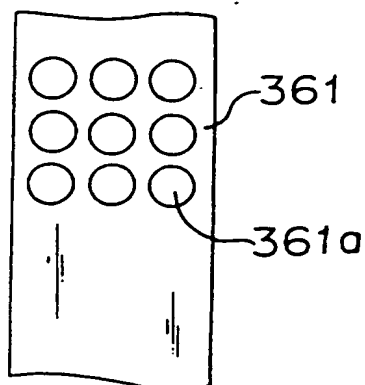


FIGURE 4 (b)

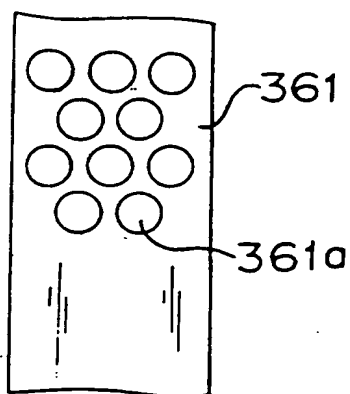
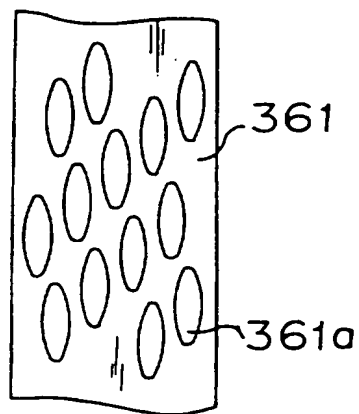
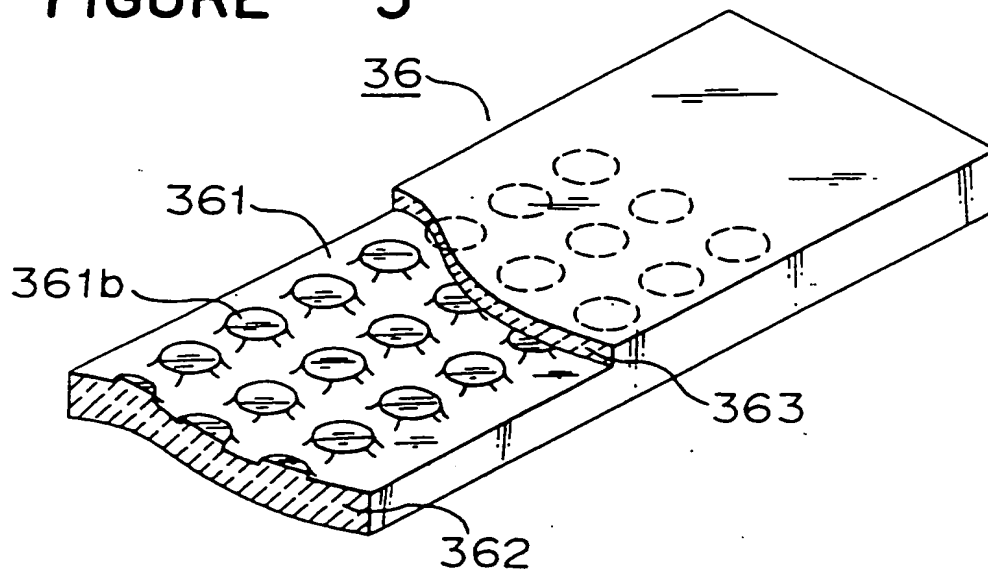


FIGURE 4 (c)



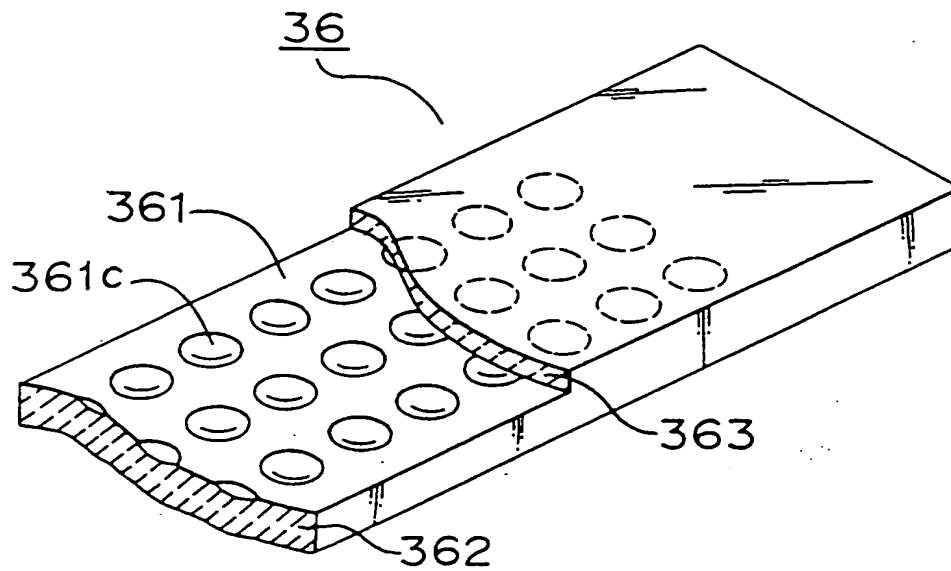
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FIGURE 5



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FIGURE 6



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FIGURE 7

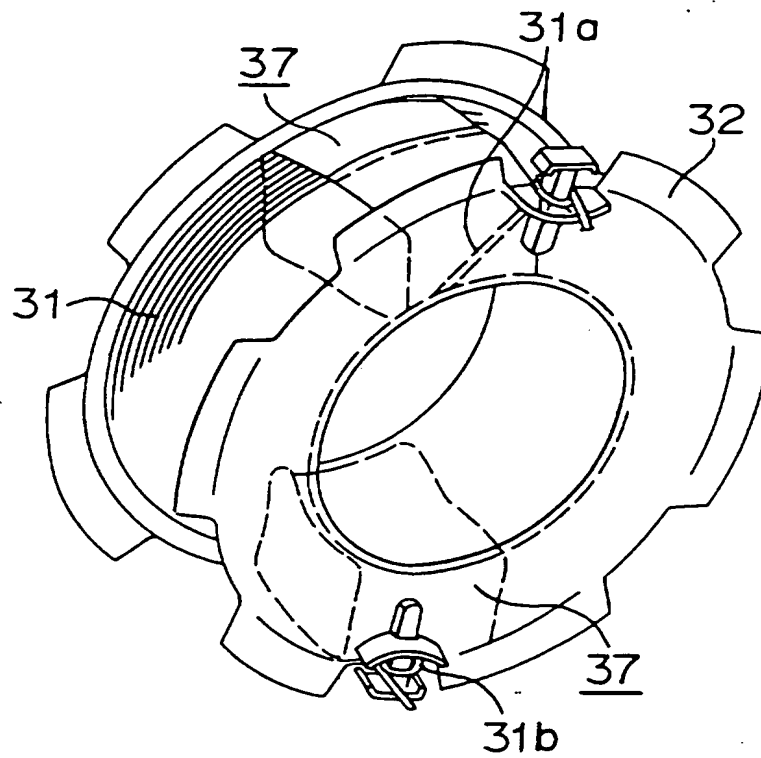
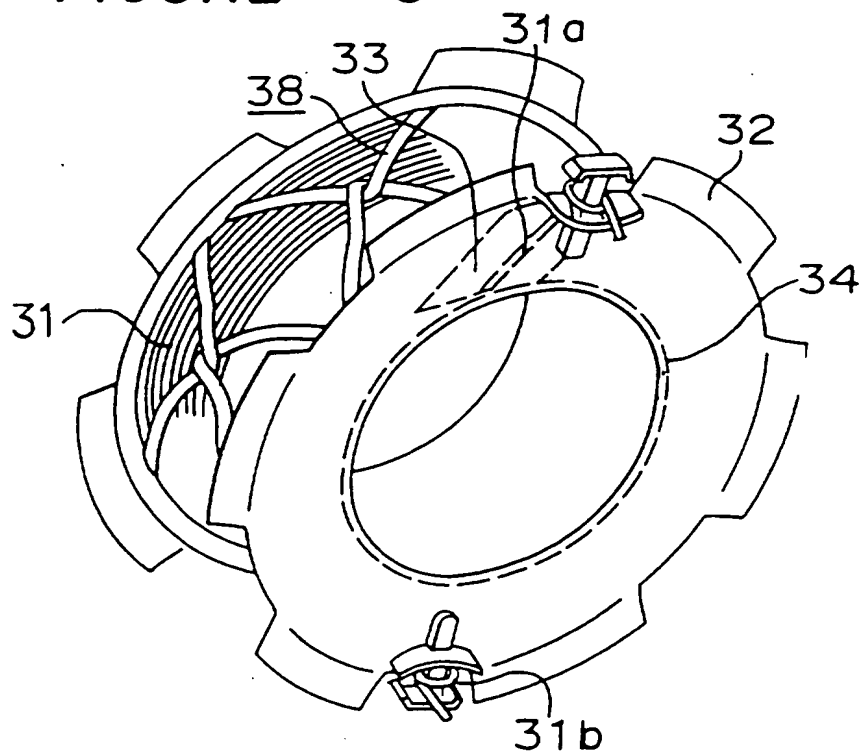
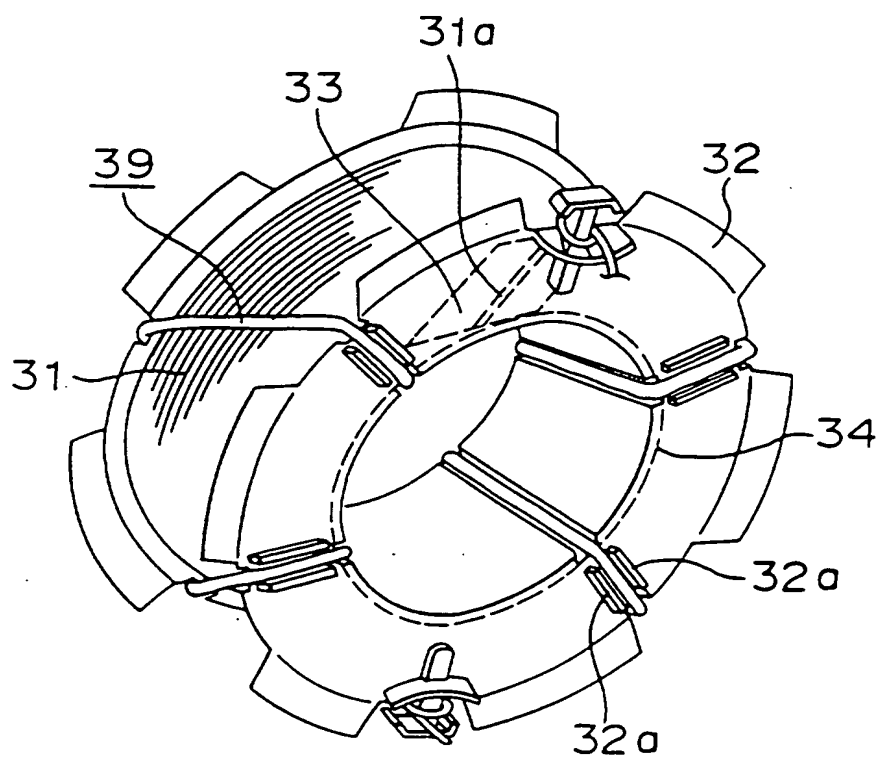


FIGURE 8



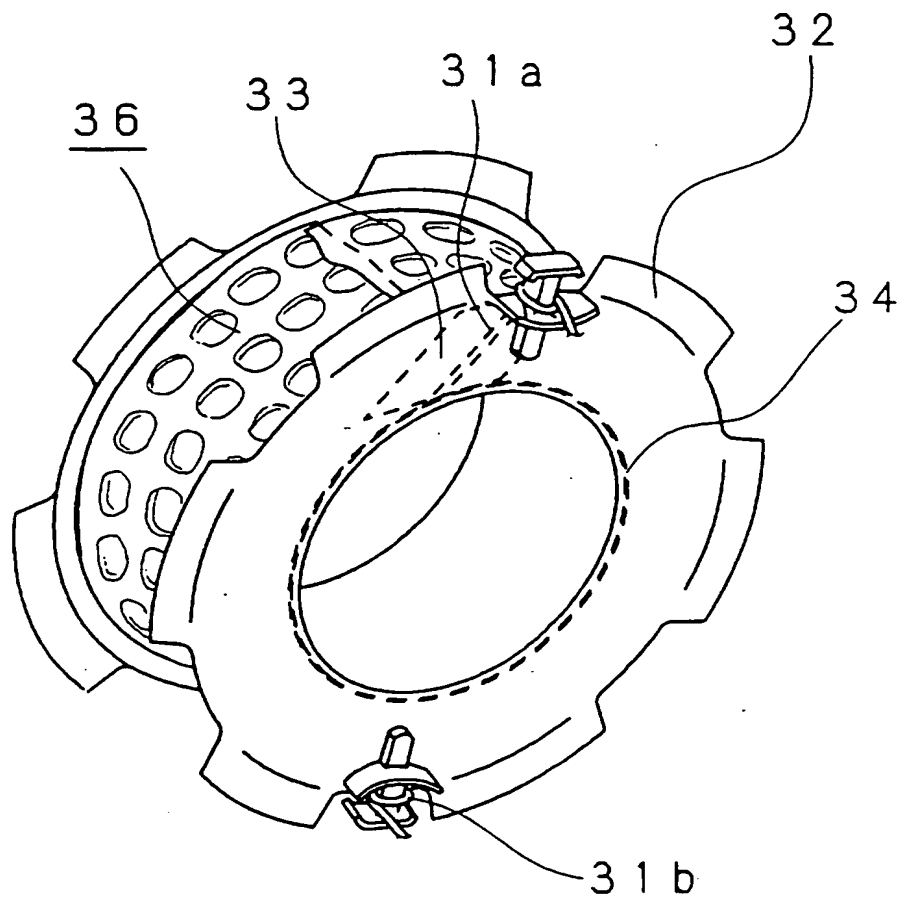
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FIGURE 9



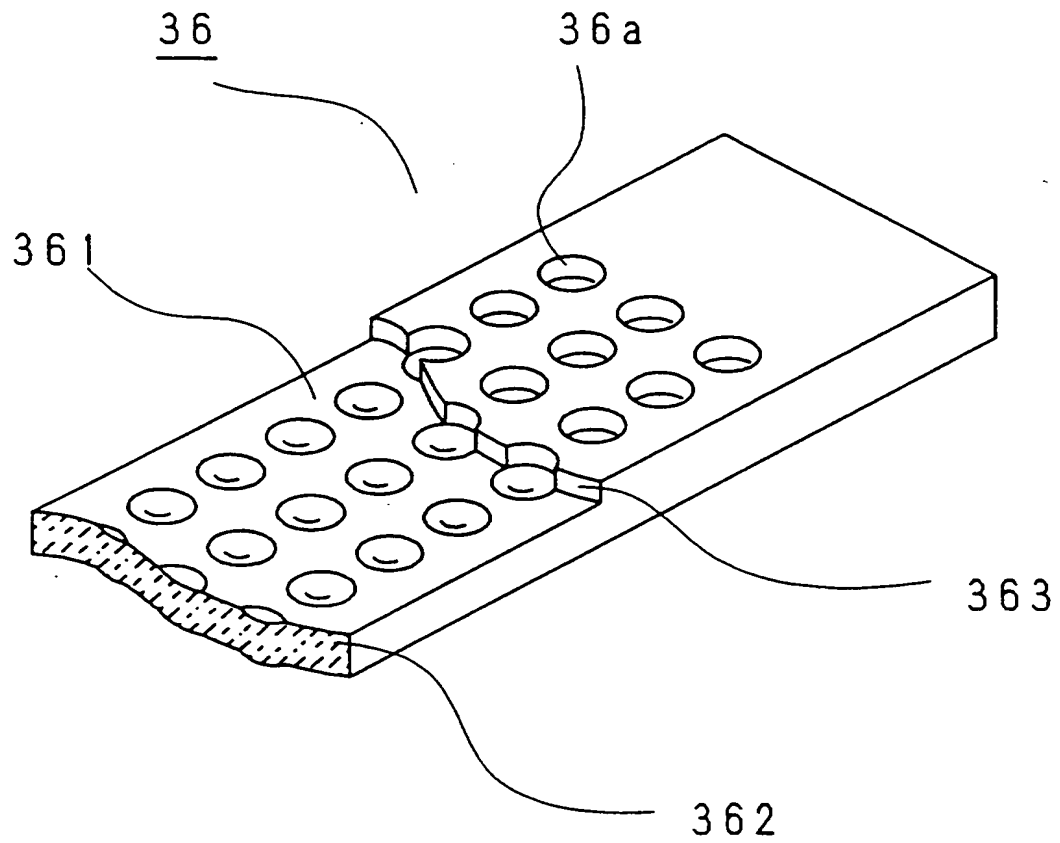
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FIGURE 10 (a)



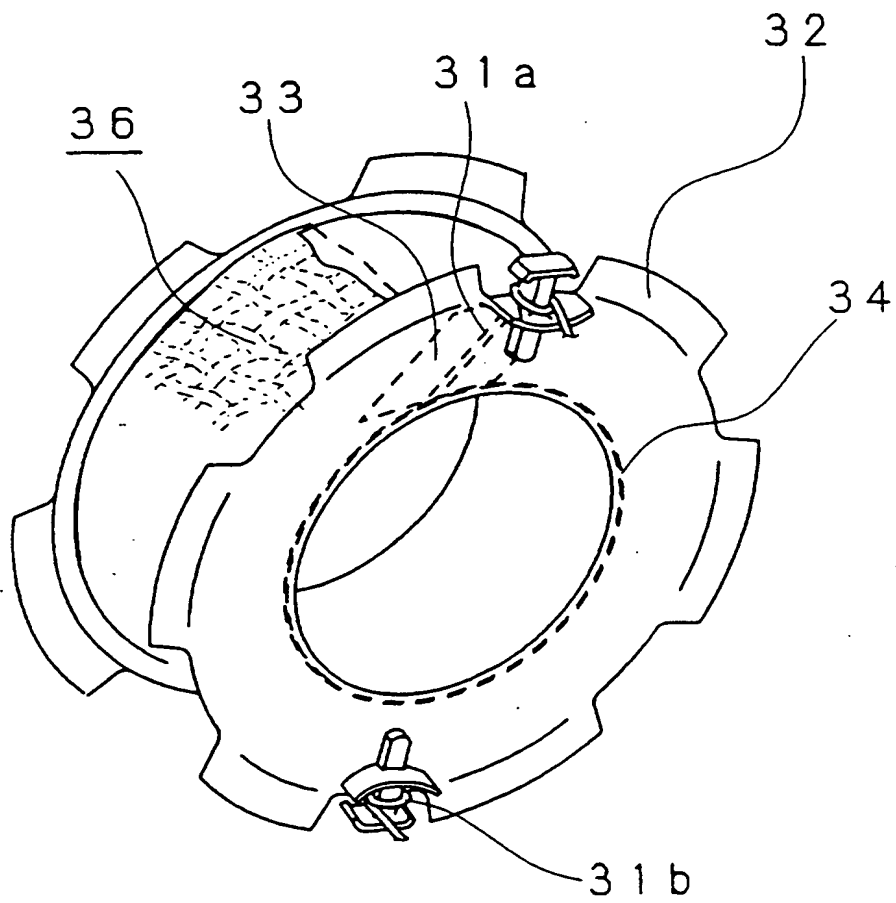
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FIGURE 10 (b)



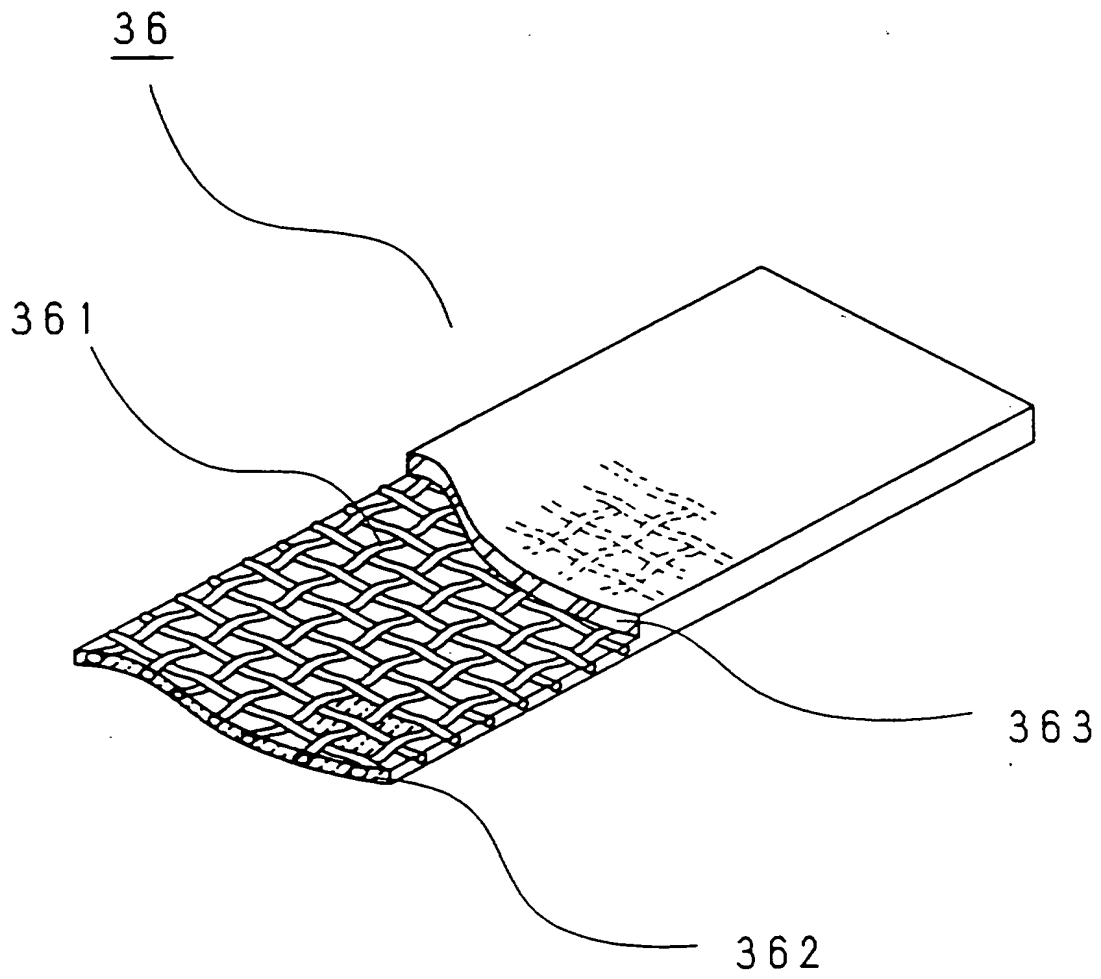
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FIGURE 11 (a)



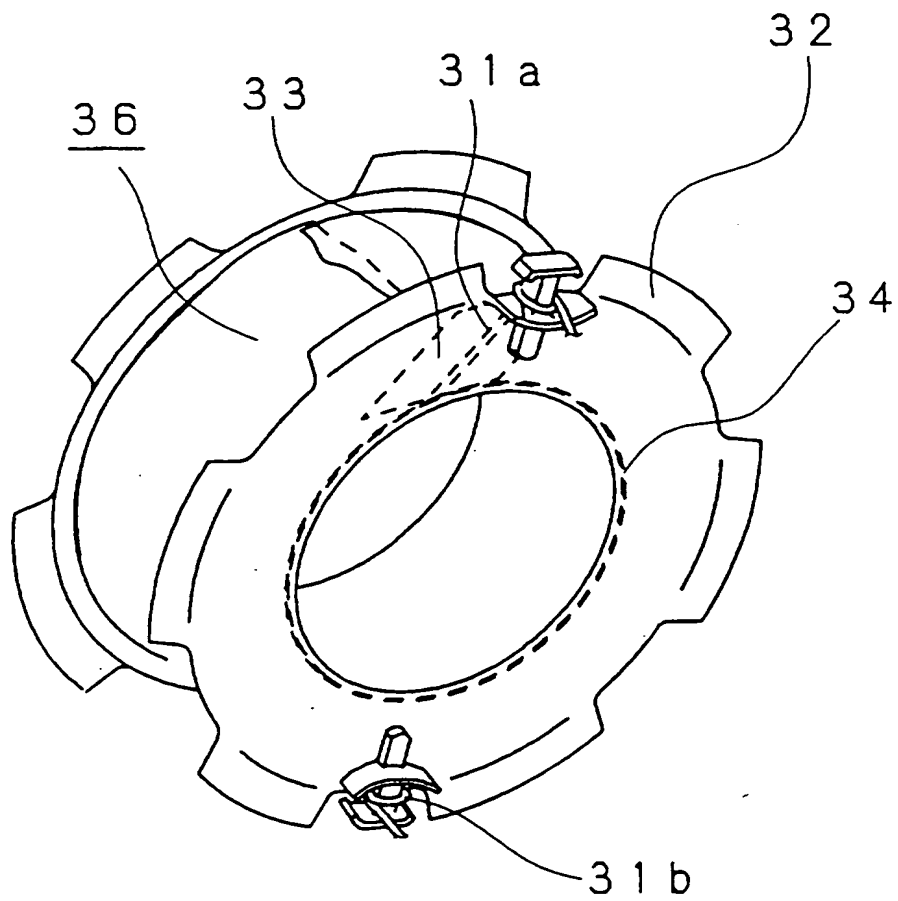
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FIGURE 11 (b)



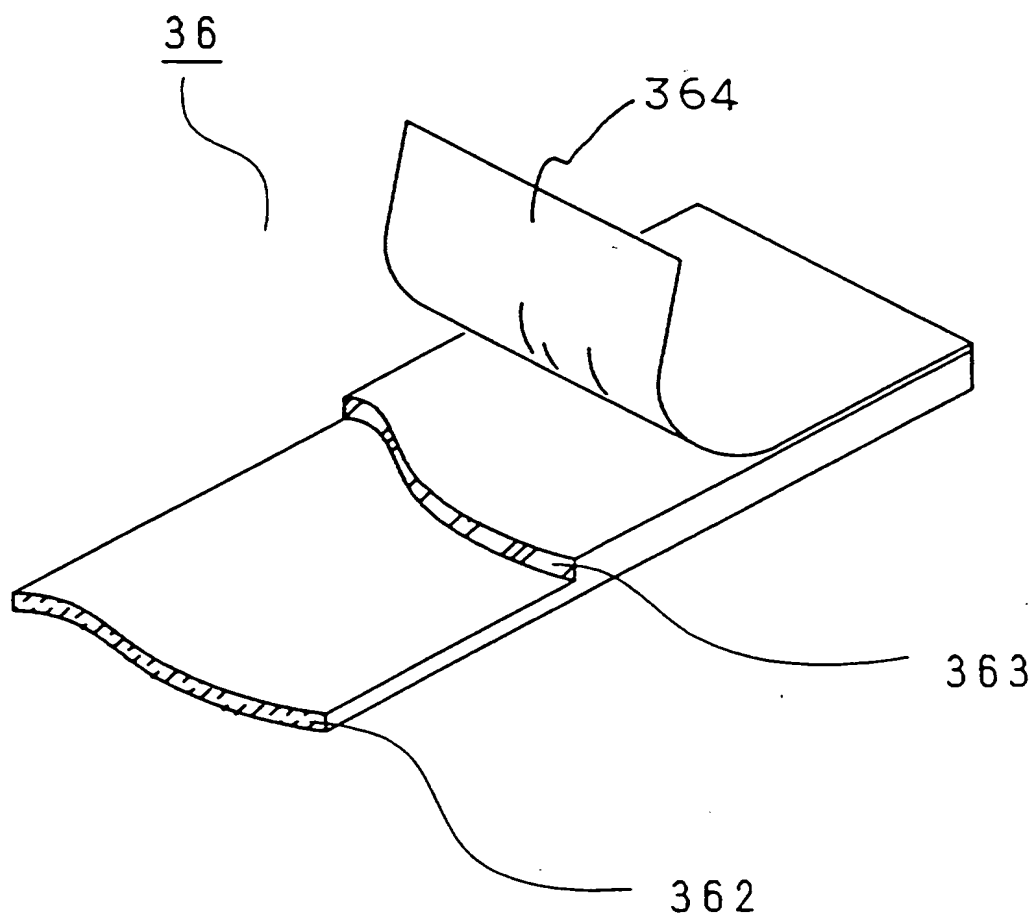
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FIGURE 12 (a)



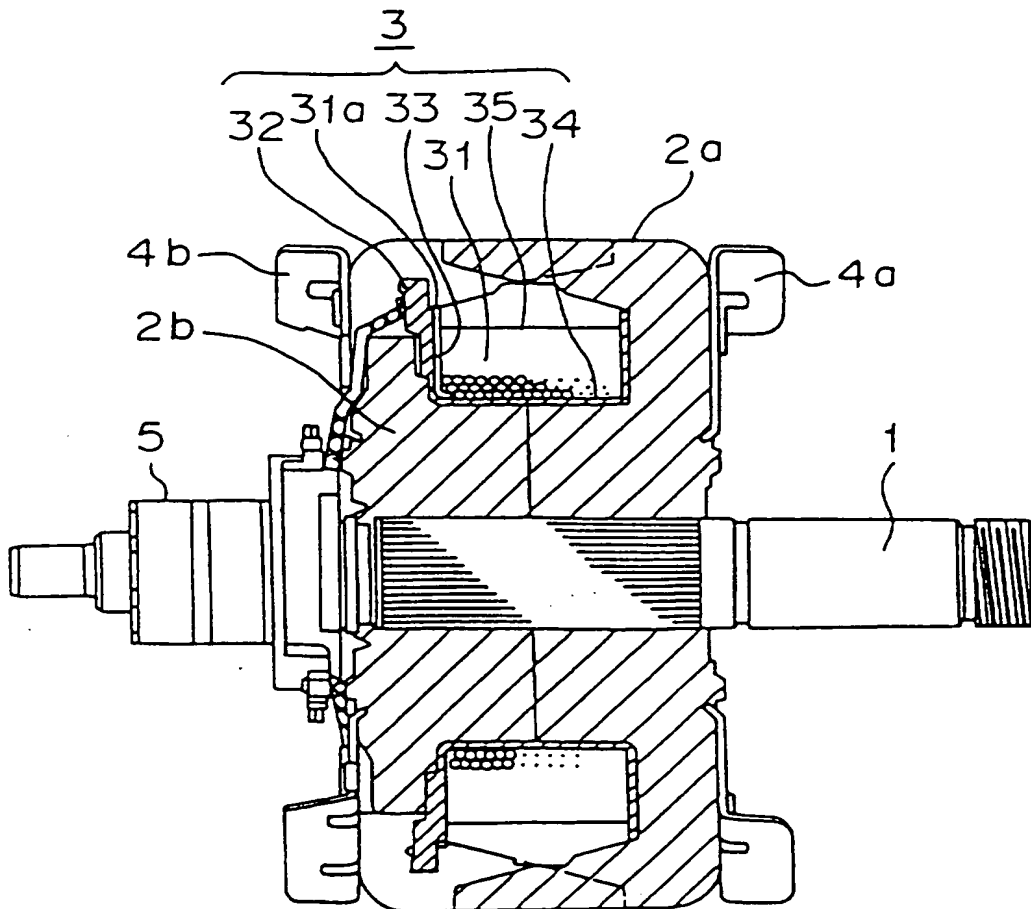
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FIGURE 12 (b)



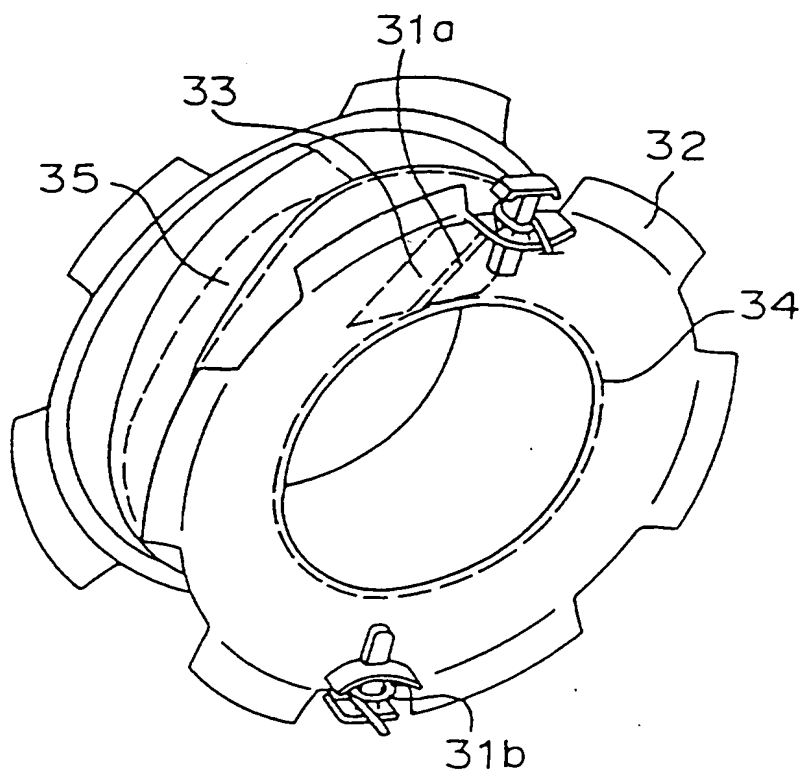
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FIGURE 13



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FIGURE 14



- 1 -

DYNAMOELECTRIC MACHINE ROTOR AND METHOD FOR PREPARING IT

The present invention relates to a rotor of a dynamoelectric machine such as an a.c. generator used for vehicles, and a method for preparing the rotor.

5 Referring to Figure 13, there is shown a cross-sectional view of the rotor of a conventional a.c. generator for vehicles. Referring to Figure 14, there is shown a perspective view of a coil assembly of the rotor. In those Figures, reference numeral 1 designates a rotary shaft which is supported by brackets of the a.c.
10 generator not shown. Reference numerals 2a and 2b field cores, which have outer circumferential portions provided with a plurality of pole claws and inner circumferential portions formed with annular channels, which are coupled
15 to form a field core member, and which are carried on and engaged with the rotary shaft 1 in such a manner that the pole claws alternately mesh one another to be opposed. Reference numeral 3 designates a coil assembly (hereinbelow, referred to as the coil ASSY). Reference
20 numeral 31 designates a field coil, which is wound on an

inner circumferential tape 34 after the tape is wound on a bobbin 32, which has an outer circumferential tape 35 wound thereon, and which is fixed on the rotary shaft 1 together with the field cores 2a and 2b. The field coil 31 has a wind-start portion 31a drawn out along a groove formed on a side of the bobbin 32, and has a side tape 33 interposed between the wind-start portion and a winding portion. Reference numerals 4a and 4b designate cooling fans, which are fixed on sides of the field cores 2a and 2b. Reference numeral 5 designates a current collector, which is carried on and engaged with the rotary shaft 1 together with the field cores 2a and 2b.

The bobbin 32 is made from of e.g. a heat-resistant nylon material. The outer circumferential tape 35 has a coil opposing surface formed as an adhesive surface, and the other surface formed as a nonadhesive surface to improve operating performance. The outer circumferential tape is formed by having a nonwoven fabric piece as a substrate impregnated with an adhesive epoxy resin, and then applying a nonadhesive epoxy resin to one of the fabric surfaces. In addition, after assembling the coil ASSY, the outer circumferential tape is subject to a heating process to have the resin melted. Then, the resin is hardened to constitute the field coil into a substantially single unit.

As stated, the conventional rotor has the inner circumference and the outer circumference of the field

coil completely covered by the tape, thereby to prevent heat build-up in the winding due to electric power generation from dissipating, causing cooling performance to deteriorate and the performance of the generator to lower. If the outer circumferential tape is eliminated because of improvement in cooling performance, a centrifugal force which is applied to the field coil could cause unwinding and cut off the field coil.

It is an object of the present invention to solve this problem, and to provide an a.c. generator rotator for vehicles capable of improving cooling performance of a field coil and of preventing the field coil from being unwound due to a centrifugal force, and to provide a method for preparing the rotor.

In accordance with the present invention, there is provided a dynamoelectric machine rotor comprising a rotary shaft; a field core member engaged with the rotary shaft; a field coil wound on the field core member through a bobbin; and an outer circumferential tape which is wound on an outer circumference of the field coil to prevent the field coil from unwinding; wherein the outer circumferential tape includes a substrate sheet which is provided with at least one of a recess and a projection.

The recess may be a hole.

The recess can be provided by making the substrate sheet of a netlike sheet.

There is also provided a dynamoelectric machine rotor

comprising a rotary shaft; a field core member engaged with the rotary shaft; a field coil wound on the field core member through a bobbin; and an outer circumferential tape which is wound on an outer
5 circumference of the field coil to prevent the field coil from unwinding; wherein the outer circumferential tape is provided with a hole.

There is further provided a dynamoelectric machine rotor comprising a rotary shaft; a field core member
10 engaged with the rotary shaft; a field coil wound on the field core member through a bobbin; and an outer circumferential tape which is made of a resin, and which is wound on an outer circumference of the field coil to prevent the field coil from unwinding; wherein the outer
15 circumferential tape is melted by a heat treatment.

There is still further provided a dynamoelectric machine rotor comprising a rotary shaft; a field core member engaged with the rotary shaft; a field coil wound on the field core member through a bobbin; and a tape
20 which is continuously wound on an inner circumference, sides and an outer circumference of a wound unit of the field coil to prevent the field coil from unwinding; wherein the tape is provided at least at a coil wind-start portion and a coil wind-completion portion.

25 The tape may comprise the outer circumferential tape which includes a substrate sheet with a recess or a projection, or which has a hole formed therein.

There is still further provided a dynamoelectric machine rotor comprising a rotary shaft; a field core member engaged with the rotary shaft; a field coil wound on the field core member through a bobbin; and a cord for
5 fixing the field coil, which has a resin impregnated thereinto or applied thereto.

There is still further provided a method for preparing a dynamoelectric machine rotor, which comprises the steps of preparing a tape by impregnating a resin
10 into or applying a resin to at least of one of a substrate sheet with a hole and a netlike substrate, and filling the hole or meshes with the resin; winding the tape on an outer circumference of a field coil which is wound on a field core through a bobbin; and melting the
15 tape by a heat treatment.

There is still further provided a method for preparing a dynamoelectric machine rotor, which comprises the steps of winding a tape of resin on an outer circumference of a field coil which is wound on a field
20 core through a bobbin; and melting the tape by heat treatment.

In the method, the tape may be prepared by impregnating a resin into or applying a resin to a substrate sheet with a hole or a netlike substrate, and
25 filling the hole or meshes with the resin.

In accordance with the dynamoelectric machine rotor thus constructed, the hole can be formed in the substrate

sheet forming the outer circumferential tape, or in the outer circumferential tape itself to improve ventilation performance of the outer circumferential tape. As a result, heat which is caused from the field coil due to electric power generation can be dissipated out of the winding, and the coil can be prevented from being unwound due to a centrifugal force.

When the substrate sheet forming the outer circumferential tape is provided with a projection or recess, the area that heat caused by the field coil due to electric power generation dissipates can be expanded to improve cooling performance.

When the substrate sheet forming the outer circumferential tape is made of a netlike sheet, the area of exposed portions of the field coil can increase not only to improve cooling performance but also to prevent the coil from being unwound due to a centrifugal force.

When the circumferential tape of resin which can be melted by heat treatment, the melted resin is impregnated into between adjoining portions of the field coil by the heat treatment after having wound the tape on the outer circumference of the field coil. The resin is hardened to prevent the coil from unwinding. The coil has the outer circumference exposed in the entirety to improve cooling performance.

When the tape which is continuously wound on the inner circumference, the sides and the outer

circumference of the wound field coil unit is provided at least at the coil wind-start portion and the coil wind-completion portion, the number of required parts can be decreased. In addition, a structure having excellent
5 ventilation can be provided to improve cooling performance of the coil, and the coil can be prevented being unwound due to a centrifugal force.

When the cord which has a resin impregnated thereinto or applied thereto is used to fix the field coil, the
10 area of the exposed portion of the field coil can be increased to improve cooling performance and to prevent the coil from being unwound due to a centrifugal force.

In drawings:

Figure 1 is a cross-sectional view showing the
15 essential parts of the a.c. generator rotator for vehicles according to an embodiment of the present invention;

Figure 2 is a perspective view showing the coil ASSY of the a.c. generator rotor of the embodiment;

20 Figure 3 is a perspective view showing the outer circumferential tape of the a.c. generator rotor of the embodiment, which includes a substrate sheet with holes;

Figures 4(a), (b) and (c) are schematic views showing various shapes and arrangements of the holes which are
25 formed in the outer circumferential tape substrate of the rotor of the embodiment;

Figure 5 is a perspective view showing the outer

circumferential tape according to a third embodiment of the present invention;

Figure 6 is a perspective view showing the outer circumferential tape according to a fourth embodiment of the present invention;

Figure 7 is a perspective view showing the coil ASSY according to a seventh embodiment of the present invention;

Figure 8 is a perspective view showing the coil ASSY according to a twelfth embodiment of the present invention;

Figure 9 is a perspective view showing the coil ASSY according to a thirteenth embodiment of the present invention;

Figure 10a is a perspective view showing the coil ASSY of the a.c. generator rotor of a second embodiment;

Figure 10b is a perspective view showing the outer circumferential tape of the rotor, which has holes formed in itself according to the second embodiment of the present invention;

Figure 11a is a perspective view showing the coil ASSY of the a.c. generator rotor of a fifth embodiment;

Figure 11b is a perspective view showing the outer circumferential tape of the rotor, which includes a substrate sheet made of a netlike sheet according to the fifth embodiment of the present invention;

Figure 12a is a perspective view showing the coil

ASSY of the a.c. generator rotor of a sixth embodiment;

Figure 12b is a perspective view showing the outer circumferential tape of the sixth embodiment, which is made of a resin member;

5 Figure 13 is a cross-sectional view showing a conventional a.c. generator rotor for vehicles; and

Figure 14 is a perspective view showing the coil ASSY of the conventional a.c. generator rotor for vehicles.

Now, the present invention will be described in
10 detail with reference to preferred embodiments illustrated in the accompanying drawings.

EMBODIMENT 1:

Figure 1 is a cross-sectional view showing the essential parts of the a.c. generator rotor for vehicle
15 according to a first embodiment of the present invention. In Figure 1, the members indicated by reference numeral 2a, 2b, 3, 31, 31a, 32, 33 and 34 are similar to those of the conventional rotors, and explanation on those members will be omitted. Reference numeral 36 designates the
20 outer circumferential tape according to the present invention. Figure 2 is a perspective view showing the coil ASSY shown in Figure 1.

In Figure 3, there is shown the outer circumferential tape 36, which comprises a substrate sheet 361, a resin
25 362 impregnated into the substrate, and a resin 363 applied to one of the surfaces of the substrate after impregnation. The substrate 361 is made of e.g. unwoven

fabric, and the resins 362 and 363 are e.g. epoxies, at least one of which has adhesive property. Reference numeral 361a designates holes which are formed in that substrate sheet 361, and which are filled with the resin 362 after impregnation. In Figures 4(a), (b) and (c), there are shown examples of the shape and arrangement of the holes 361a. In the example shown in Figure 4a, a plurality of circular holes are formed in a triple file in the longitudinal direction of the substrate sheet. In the example shown in Figure 4b, a plurality of circular holes are formed in such a manner that holes in a trio and holes in a duo are repeatedly alternating. In the example shown in Figure 4c, a plurality of elliptical holes are formed so as to successively shift one another in the longitudinal direction of the substrate sheet.

In a heat treatment process for preparation of the rotor according to the embodiment, the resins 362 and 363 of the outer circumferential tape which has been wound on the field coil 31 are melted to fill in between adjoining portions of the field coil, and then are hardened again to constitute the field coil 31 into a substantially single unit. As a result, most of the holes 31a are exposed, thereby offering an effect like an increase in the surface roughness of the field coil 31, and decreasing heat-conducting resistance with cooling air to improve cooling performance.

EMBODIMENT 2:

Although in the first embodiment the holes are formed in the substrate 361 which forms a part of the outer circumferential tape 6, the holes can be formed in the outer circumferential tape 36 itself (see Figures 10a, 10b), offering similar advantages.

EMBODIMENT 3:

As shown in Figure 5, the substrate 361 of the outer circumferential tape 36 can have a plurality of projections 361b formed thereon. According to this embodiment, the area that the field coil can dissipate heat can be enlarged, offering similar advantages.

EMBODIMENT 4:

As shown in Figure 6, the substrate 361 which forms a part of the outer circumferential tape 36 can have a plurality of recesses 361c formed therein, offering advantages similar to the third embodiment.

EMBODIMENT 5:

The substrate of the outer circumferential tape 36 may be made of a netlike sheet (see Figures 11a, 11b) to increase the area of the exposed portions of the coil while maintaining required strength for the tape.

EMBODIMENT 6:

Although in the first embodiment the outer circumferential tape 36 is constituted by the substrate 361 and the resins, the tape may be constituted by only resin materials 362, 363 (Figures 12a, 12b), offering

similar advantages. Reference numeral 364 designates released paper.

EMBODIMENT 7:

In Figure 7, there is shown the coil ASSY according to a seventh embodiment of the present invention. Reference numeral 37 designates tapes which are wound on the wound field coil from its inner circumference to its outer circumference passing its sides, which are provided at least at a wind-start portion 31a and at a wind-completion portion 31b, and which is made of a material similar to the conventional tape. According to this embodiment, the side tape 33 can be eliminated to establish a reduction in the number of required parts. In addition, the coil ASSY can have high heat dissipation performance.

EMBODIMENT 8:

The tape according to the seventh embodiment may have an outer circumferential portion constituted by a substrate sheet with a plurality of holes as stated with respect to the first embodiment. In this case, similar advantages are obtainable.

EMBODIMENT 9:

The tape according to the seventh embodiment may have an outer circumferential portion formed with a plurality of holes like the tape of the second embodiment.

EMBODIMENT 10:

The tape according to the seventh embodiment may

includes a substrate which has a plurality of projection formed thereon like the third embodiment. In this case, similar advantages can be obtained.

EMBODIMENT 11:

5 The tape according to the seventh embodiment can include a substrate which has a plurality of recesses formed therein like the fourth embodiment. In this case, similar advantages can be obtained.

EMBODIMENT 12:

10 In Figure 8, there is shown the coil ASSY according to a twelfth embodiment of the present invention. Reference numeral 38 designates a cord member which is e.g. a heat-shrinkable type cord which has a resin impregnated thereinto or applied thereto. The cord
15 member fixes the field coil in e.g. a grid pattern. According to this embodiment, a heat treatment process for preparation of the rotor causes not only the resin to be melted and hardened but also the cord itself to be shrunk to fix the field coil further firmly.

20 EMBODIMENT 13:

As shown in Figure 9, the cord member 39 is arranged to wind the field coil together with the bobbin 32 at several locations to obtain similar advantages in a simple structure. When the bobbin has side surfaces
25 formed with cord member guides 32a, the bobbin itself can not be prevented from rotating.

CLAIMS:

1. A dynamoelectric machine rotor comprising:

a rotary shaft;

a field core member engaged with the rotary shaft;

5 a field coil wound on the field core member through a bobbin; and

an outer circumferential tape which is wound on an outer circumference of the field coil to prevent the field coil from unwinding;

10 wherein the outer circumferential tape includes a substrate sheet which is provided with at least one of a recess and a projection.

2. A dynamoelectric machine rotor according to Claim 1, wherein the recess is a hole.

15 3. A dynamoelectric machine rotor according to Claim 1, wherein the recess is provided by making the substrate sheet of a netlike sheet.

4. A dynamoelectric machine rotor comprising:

a rotary shaft;

20 a field core member engaged with the rotary shaft;

a field coil wound on the field core member through a bobbin; and

25 an outer circumferential tape which is wound on an outer circumference of the field coil to prevent the field coil from unwinding;

wherein the outer circumferential tape is provided with a hole.

5. A dynamoelectric machine rotor comprising:

a rotary shaft;

a field core member engaged with the rotary shaft;

a field coil wound on the field core member through a

5 bobbin; and

an outer circumferential tape which is made of a resin, and which is wound on an outer circumference of the field coil to prevent the field coil from unwinding;

10 wherein the outer circumferential tape is melted by a heat treatment.

6. A dynamoelectric machine rotor comprising:

a rotary shaft;

a field core member engaged with the rotary shaft;

a field coil wound on the field core member through a

15 bobbin; and

a tape which is continuously wound on an inner circumference, sides and an outer circumference of a wound unit of the field coil to prevent the field coil from unwinding;

20 wherein the tape is provided at least at a coil wind-start portion and a coil wind-completion portion.

7. A dynamoelectric machine rotor according to Claim 6, wherein the tape comprises the outer circumferential tape defined in any one of Claims 1, 2 and 4.

25 8. A dynamoelectric machine rotor comprising:

a rotary shaft;

a field core member engaged with the rotary shaft;

a field coil wound on the field core member through a bobbin; and
a cord for fixing the field coil, which has a resin impregnated thereinto or
applied thereto.

9. A method for preparing a dynamoelectric machine rotor, which comprises the
steps of:

preparing a tape by impregnating a resin into or applying a resin to at least one
of a substrate sheet with a hole and a netlike substrate, and filling the hole or meshes
with the resin;

winding the tape on an outer circumference of a field coil which is wound on a
field core through a bobbin; and

melting the tape by heat treatment.

10. A method for preparing a dynamoelectric machine rotor, which comprises the
steps of:

winding a tape of resin on an outer circumference of a field coil which is wound
on a field core through a bobbin; and

melting the tape by heat treatment.

11. A method of preparing a dynamoelectric machine rotor, substantially as herein
described with reference to any of Figures 1 to 12 of the accompanying drawings.

12. A dynamoelectric machine rotor substantially as herein described with reference
to Figures 1 to 4 or any of Figures 6 to 12b of the accompanying drawings.



Application No: GB 9509195.5
Claims searched: 1-3

Examiner: Mr J Cockitt
Date of search: 28 July 1995

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.N): H2A [AKH2A, AKH2, AKH1, AKD2C, AKD2D, AKD2, AKN2A, AKF1]

Int Cl (Ed.6): H02K [03/34, 03/52, 03/18, 15/04, 15/095, 15/10, 15/12]; H01F [05/02, 05/06, 41/06]

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	EP0062602A2 SIEMENS - see porous support layer	1 at least
X	EP0019815A1 SIEMENS - see porous layer	1 at least
X	EP0012566A1 HITACHI - see glass cloth	1 at least
X	US4806806A ASEA - see spaces between mica flakes	1 at least
X	US4008409A GEC - see ridges of material	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.



Application No: GB 9509195.5
Claims searched: 4

Examiner: John Cockitt
Date of search: 26 October 1995

Patents Act 1977
Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.N): H2A [AKH2A, AKH2, AKH1, AKD2C, AKD2D, AKD2, AKN2A, AKF1]; H1P [PHC]; HIT

Int Cl (Ed.6): H02K [03/34, 03/40, 03/52, 15/02, 15/04, 15/06, 15/095, 15/10, 15/12]; H01F [05/02, 05/06, 41/06, 41/12]

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB2209879A	JOHNSON - see fig	4
X	GB0901016A	ALLMANNA - see perforations in tape to permit encapsulation	4
X	GB0567074A	IGRANIC - see perforate wrapping 14	4

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.



Application No: GB 9509195.5
Claims searched: 5,9,10

Examiner: John Cockitt
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Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK Cl (Ed.N): H2A [AKH2A, AKH2, AKH1, AKD2C, AKD2D, AKD2, AKN2A, AKF1]; H1T; H1P [PHC]
Int Cl (Ed.6): H02K [03/34, 03/40, 03/52, 15/02, 15/04, 15/06, 15/095, 15/10, 15/12]; H01F [05/02, 05/04, 05/06, 41/06, 41/12]
Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB1114506A GEC - see fig 1 layer 18	5,9,10
X	EP0116367A1 TOKYO - see p2 ln24-ln28, p7 ln9-p9 ln5	5,9,10
X	EP0368038A1 BROWN - see hot melt resin 4,5 fig 1	5,9,10
X	US4400226A GEC - see col6 ln30-col7 ln42	5,9,10

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